



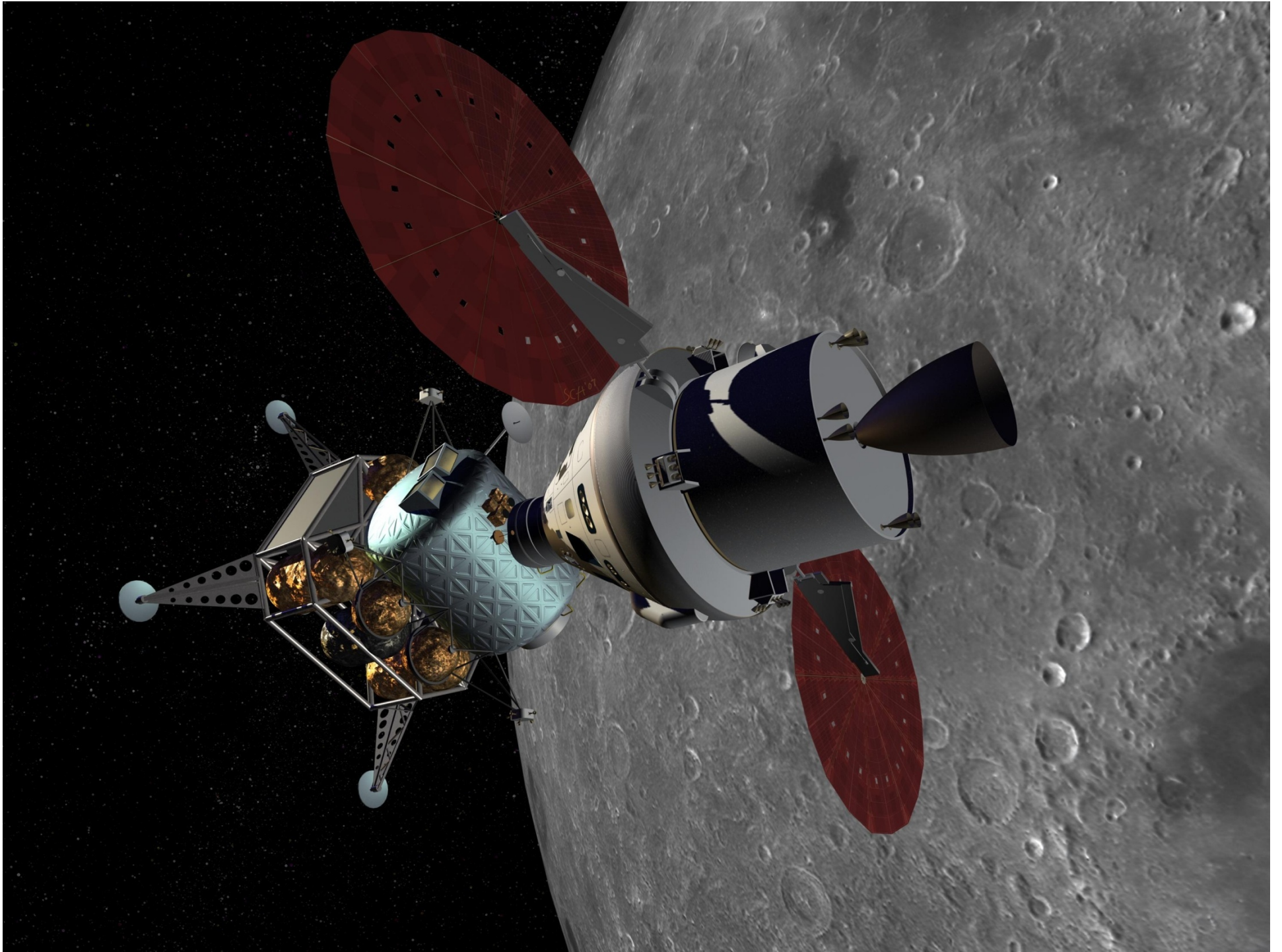
## ***GFE Project Management: Meeting the Challenge!***

**Low Impact Docking System (LIDS)**

**Johnson Space Center, Houston, Texas**

**James L. Lewis, Senior Project Manager, LIDS**

**[james.l.lewis@nasa.gov](mailto:james.l.lewis@nasa.gov)**





## ***The LIDS Management Team***



**My Acknowledgement to the whole LIDS Project Management Team and Discipline Leads and my personal gratitude for their Support!**

- ◆ Monty Carroll, Chief Engineer**
- ◆ Landon Moore, Deputy Project Manager**
- ◆ Brandon Burns, ESCG Project Manager**
- ◆ Ray Morales, Senior Electrical Engineer**
- ◆ Thang Le, Senior Mechanical Engineer**
- ◆ Benjamin Quasius, Structural & Stress Analysis Lead**
- ◆ Stephen Porter, JSC/EA Project Executive**
- ◆ Timothy Trueblood, Project Management Consultant**



# Project Management



photo courtesy of [www.platespinning.com](http://www.platespinning.com)

- ◆ The Art of Project Management is like a Circus Act in many ways
- ◆ Many cite or use the “Juggling” analogy but I prefer that of the “Plate Spinner”
- ◆ A good “spin” allows a plate to be left alone briefly while other or new activities are attended too.
- ◆ Individual plates have individual needs; some need more attention than others
- ◆ The plate “wobble” is usually indicative of the need for attention well before a crash
- ◆ Sometimes others can help keep a plate spinning



## ***A Quick Look at a GFE Project, from a Project Manager's Point of View***



- ***The Low Impact Docking System (LIDS)***
- ***Government Furnished Equipment (GFE)***
- ***The LIDS and the Project Lifecycle Overview***
- ***Planning, Planning, Planning....POP***
- ***Initial Project Planning & Process Development (Schedule & Budget), Team Structure and Project Profile, Defining Project Management Practices, Methodologies and Tools Requirements***
- ***Detailed Planning & Schedule Development – at the Work Package Level***
- ***Integrating EVM Practices and Processes into the Project***





## ***What this presentation is about :***



***Because of time limitations, this presentation will only be a cursory look at how we plan, design, and use project management in the development of space exploration hardware;***

***This presentation will show how we use both a top-down and a bottom-up approach in project management; using well established project management practices, processes, and methodologies;***

***We'll also discuss some of the barriers, the technical challenges in the product design, as well as project management challenges with schedule and budget resources.***



## ***And, what this presentation is not about:***

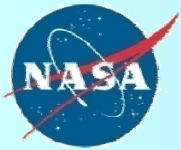


***One size does not fits all;***

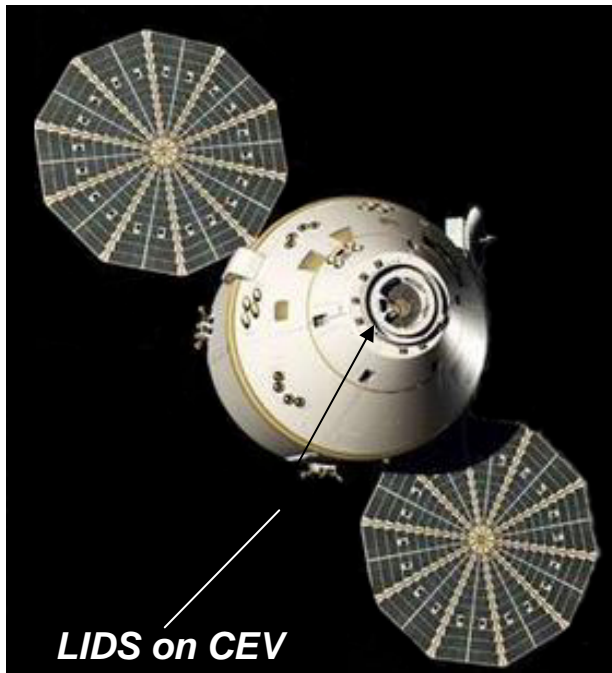
***We have developed a project management strategy that works  
for the LIDS project;***

***some of what we do is common in most GFE projects, in one  
form or another;***

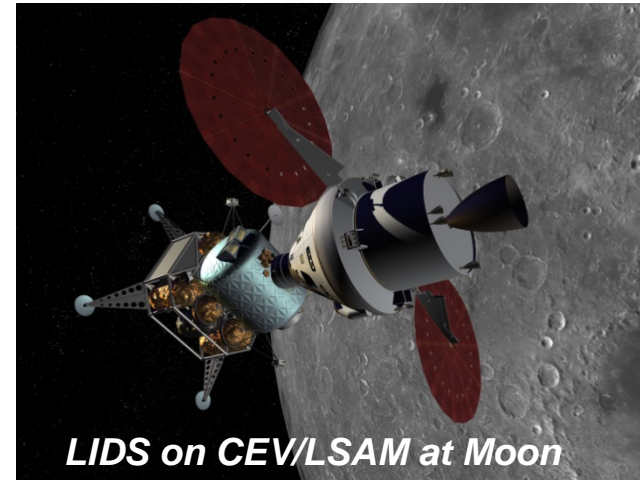
***Finding the project management solutions for your project is  
often as important as the technological advancement we strive  
for in space flight engineering.***



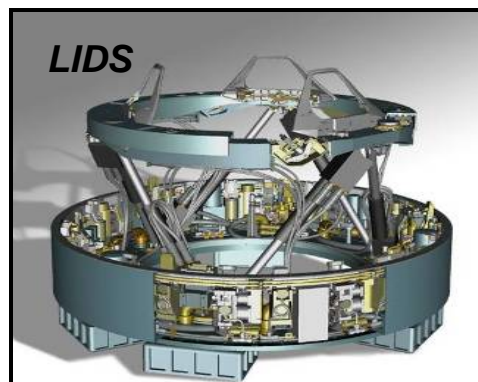
# *The Low Impact Docking System (LIDS)*



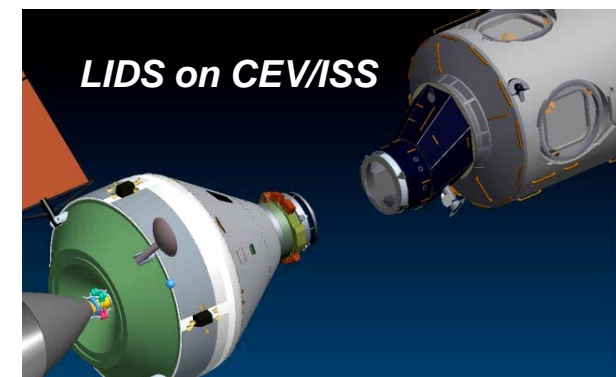
*LIDS on CEV*



*LIDS on CEV/LSAM at Moon*



*LIDS*

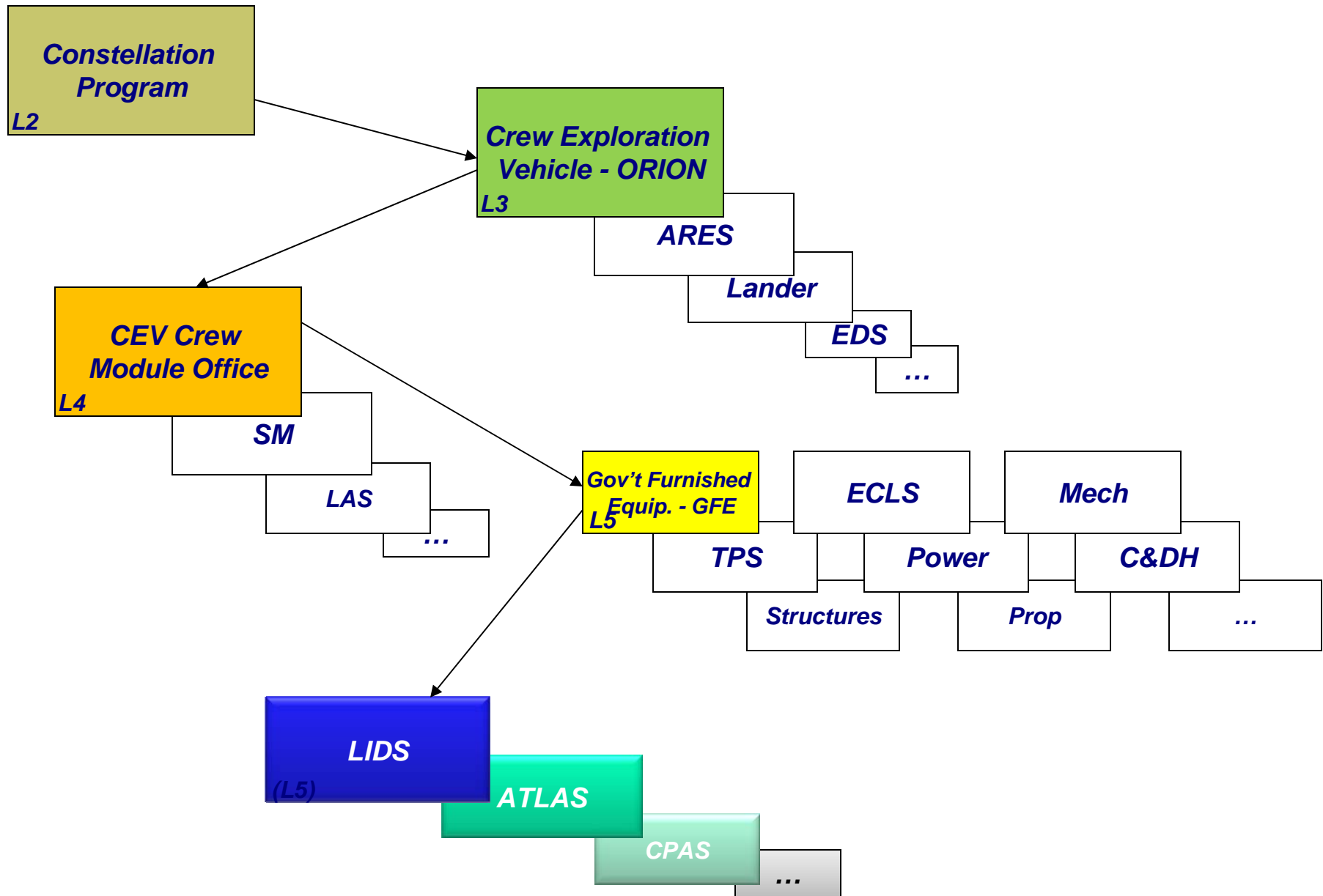


*LIDS on CEV/ISS*



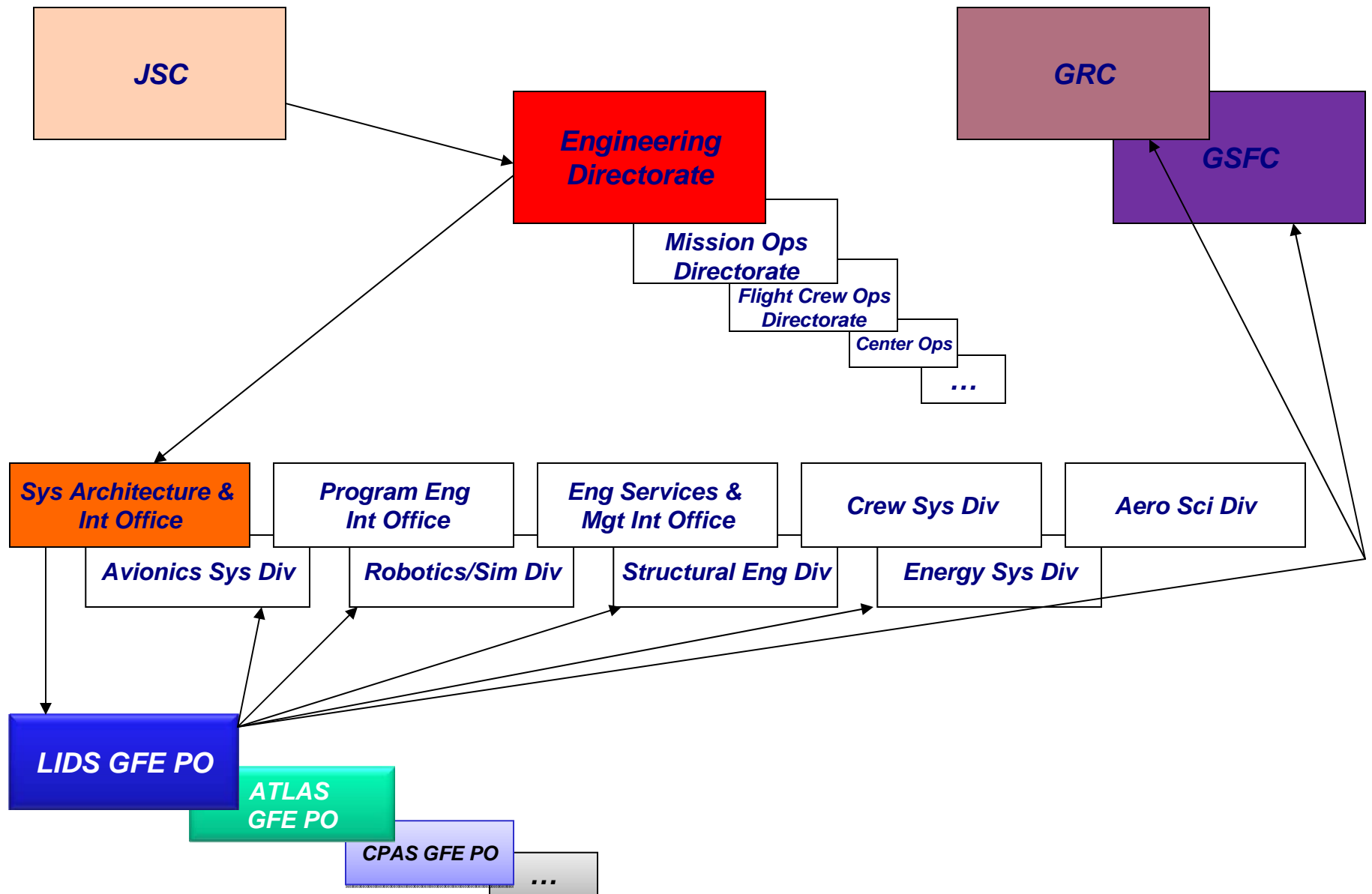


# Program Organizational Chart





# JSC Organizational Chart





## ***GFE Engineering Practices – Engineering Directorate***



**Within the JSC Engineering Directorate, there are Work Instructions to guide flight development:**

- *EA-WI-023, “Project Management of Government Furnished Equipment (GFE) Flight Projects”*
- *EA-WI-025, “GFE Flight Project Software and Firmware Development”*

***These WI are derived from higher level documents (e.g. NASA NPR's) and define roles and responsibilities and the minimum set of requirements and products for conducting:***

- ***Systems Requirements Review (SRR);***
- ***Preliminary Design Reviews (PDR);***
- ***Critical Design Review (CDR); and ,***
- ***System Acceptance Review (SAR).***

***However, traditionally, these WI's were written for small projects with small teams and not large complex GFE activities. As such, as a Project, we have/are developing additional process instructions to bridge the gaps.***

- LIDS-WI-001 Review Process
- LIDS-WI-002 Work Authorization Documents
- LIDS-WI-003 Work Package Definition and Tracking Process
- LIDS-WI-004 Purchasing Process
- LIDS-WI-005 Make\_Buy Process
- LIDS-WI-006 Perf Measurement
- LIDS-WI-007 Drawing and Models Approval and Delivery Process
- LIDS-WI-008 Request for Information (RFI)
- LIDS-WI-009 Change Request (CR) Process
- LIDS-WI-010 Request for Fabrication Estimate
- LIDS-WI-011 Shipping and Receiving Process
- LIDS-WI-012 New Personnel Requisition Process
- LIDS-WI-013 New Personnel Services Request and Orientation Process
- LIDS-WI-014 Status Reporting Process
- LIDS-WI-015 Testing Process
- LIDS-WI-016 Risk Management Process
- LIDS-WI-017 Configuration Management Process



## ***Other Procedures & Guidelines***



### ***NASA Procedural Requirements 7120.5D***

#### ***NASA Space Flight Program and Project Management Requirements Responsible Office: Office of the Chief Engineer***

***This document establishes the process by which NASA will formulate and implement space flight programs and projects consistent with the governance model contained in NPD1000.0, NASA Strategic Management and Governance Handbook.***

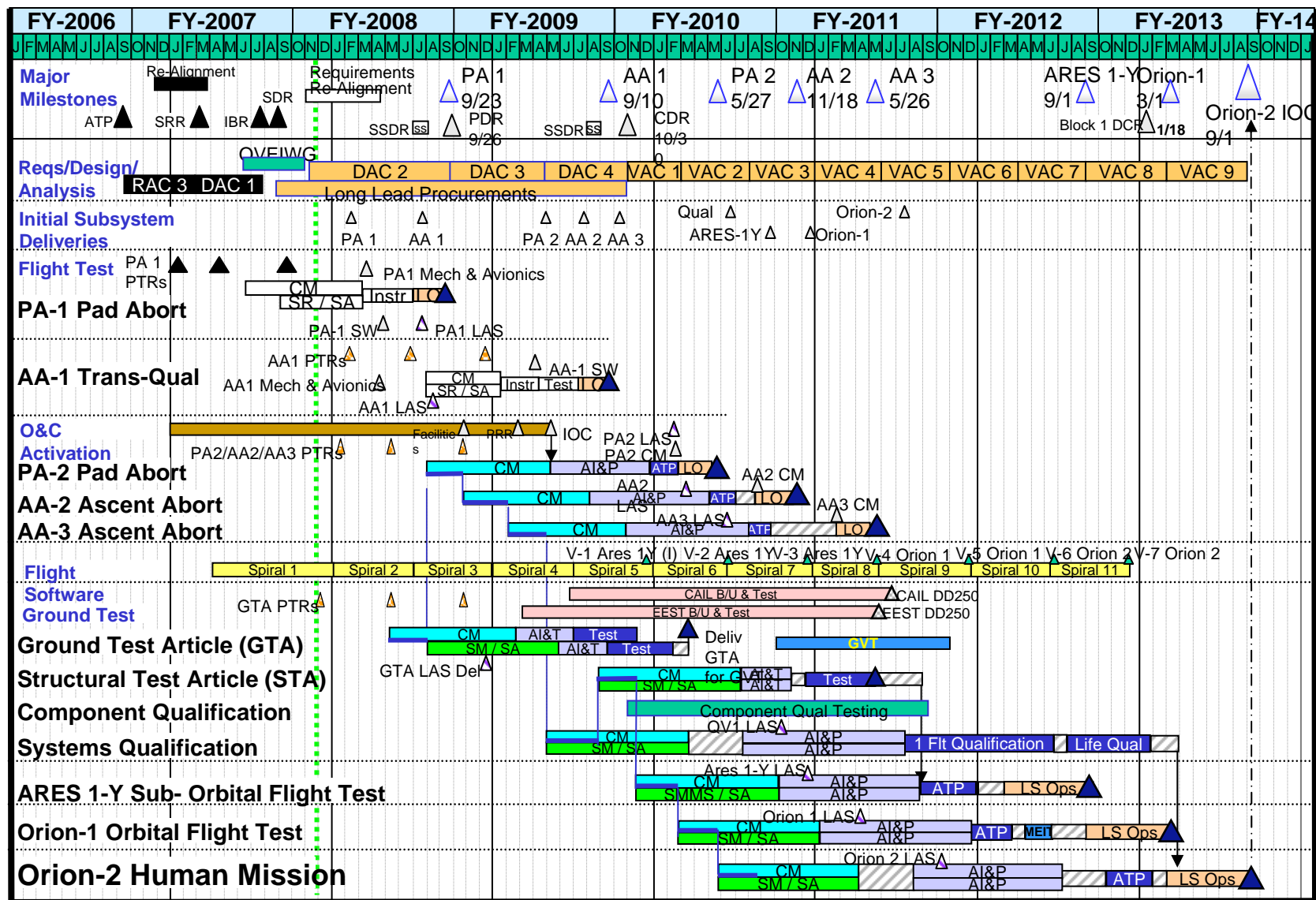
***This document is intended to establish a standard of uniformity in the management of such programs and projects.***

### ***Project Management Institute - Project Management Body of Knowledge v3 (PMBOK)***

- ***Earned Value Management - Global Standard***
- ***Practice Standard for Scheduling - Global Standard***
- ***Practice Standard for Work Breakdown Structures - Global Standard***
- ***Government Extension to the PMBOK***
- ***Program Management - Global Standard***
- ***Portfolio Management - Global Standard***
- ***Organizational Project Management Maturity Model***



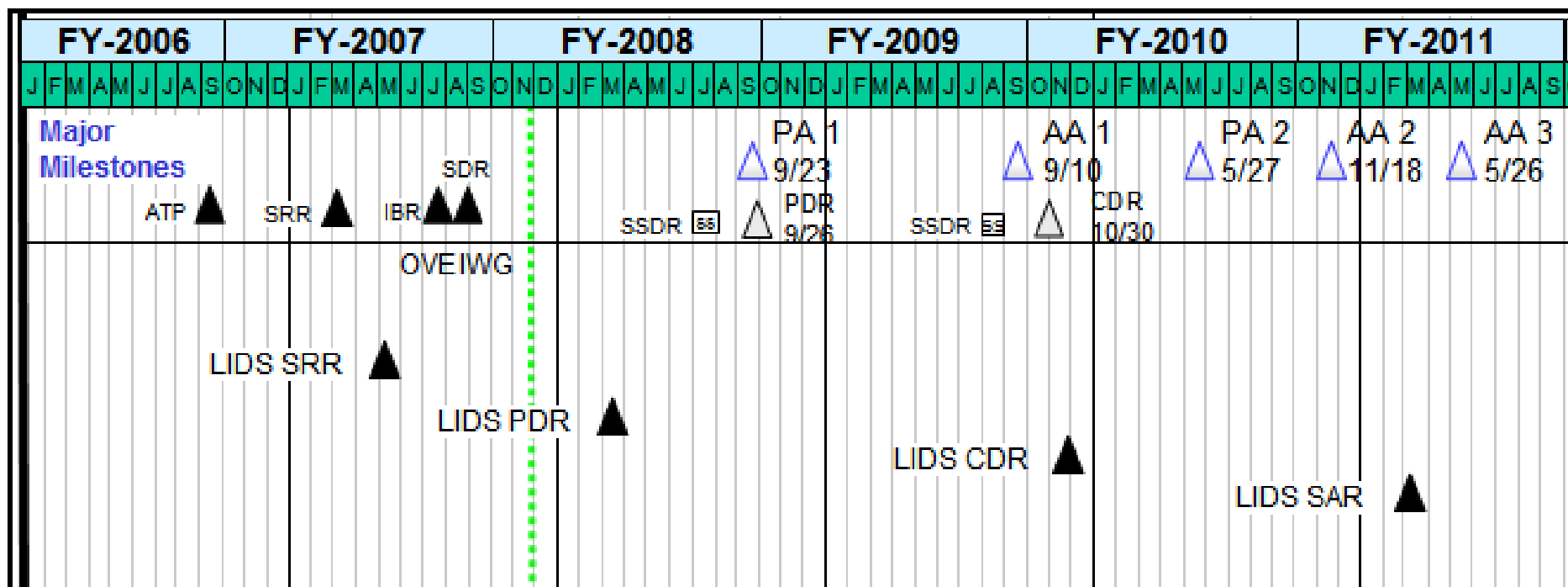
# Orion Master Schedule (Dec 07)

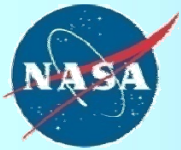




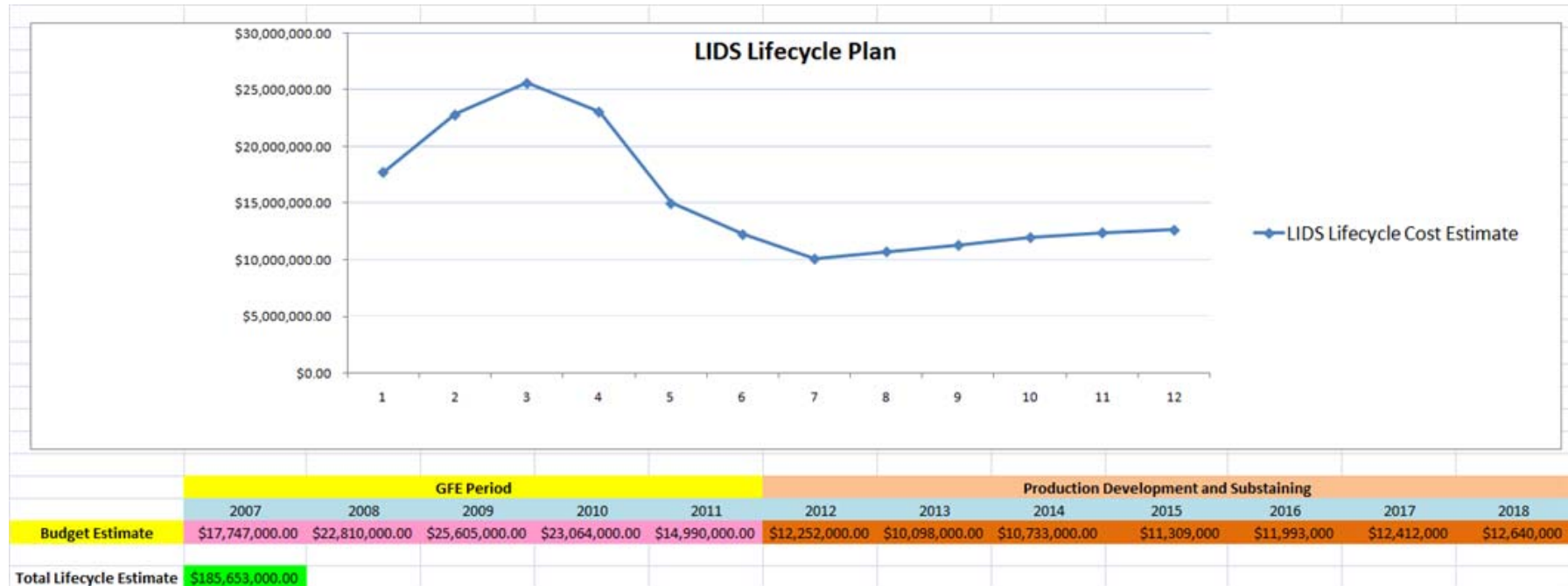


# LIDS Master Schedule w/ Orion Overlay (Dec 07)





# LIDS Project Budget Lifecycle





# ***Initial Project Planning for Schedule & Budget***

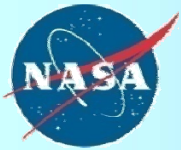


## ***Planning, Programming, Budget, and Execution (aka, PPBE or formerly POP)***

***What is PPBE? -- A More Strategic Approach to Budgeting...Fundamentally a shift from budgeting for discrete projects to an integrated architecture of programs and projects aligned with NASA's Mission and Vision for Space Exploration.***

- The Planning process begins about sixteen months in advance of the fiscal year for which the budget authority is requested. The President's goals for the Agency guide the Planning phase.***
- A unique aspect of PPBE is the emphasis on Programming, this phase involves high-level, multi-year, strategic analyses of Agency capabilities and capacities. During this phase, NASA analyzes the potential long-term impact of programs to answer the question, "Will the proposed programs help NASA achieve the Agency's strategic goals?" It is also when planning decisions, programming and congressional guidance is converted into a detailed allocation of resources.***
- The Budgeting phase (formulation and justification) provides a platform for a detailed review of a program's pricing, phasing, and overall capability to be executed on time and within budget.***
- Current year budget Execution begins on October 1. During execution, funds are allocated, obligated, and expended to accomplish Agency plans. In addition, execution entails the monitoring and reporting of actual results to budgeted, anticipated results, along with causes of variances and planned corrective actions, if necessary.***

***[www.nasa.gov/pdf/155904main\\_MASTER%20FMR%20V4%20071806%20FINAL%20508%20compliance%208-11-2006.pdf](http://www.nasa.gov/pdf/155904main_MASTER%20FMR%20V4%20071806%20FINAL%20508%20compliance%208-11-2006.pdf)***



# Team Structure and Project Profile



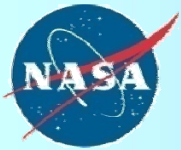
**RESPONSIBILITY  
ASSIGNMENT  
MATRIX  
(RAM)**

**OBS**

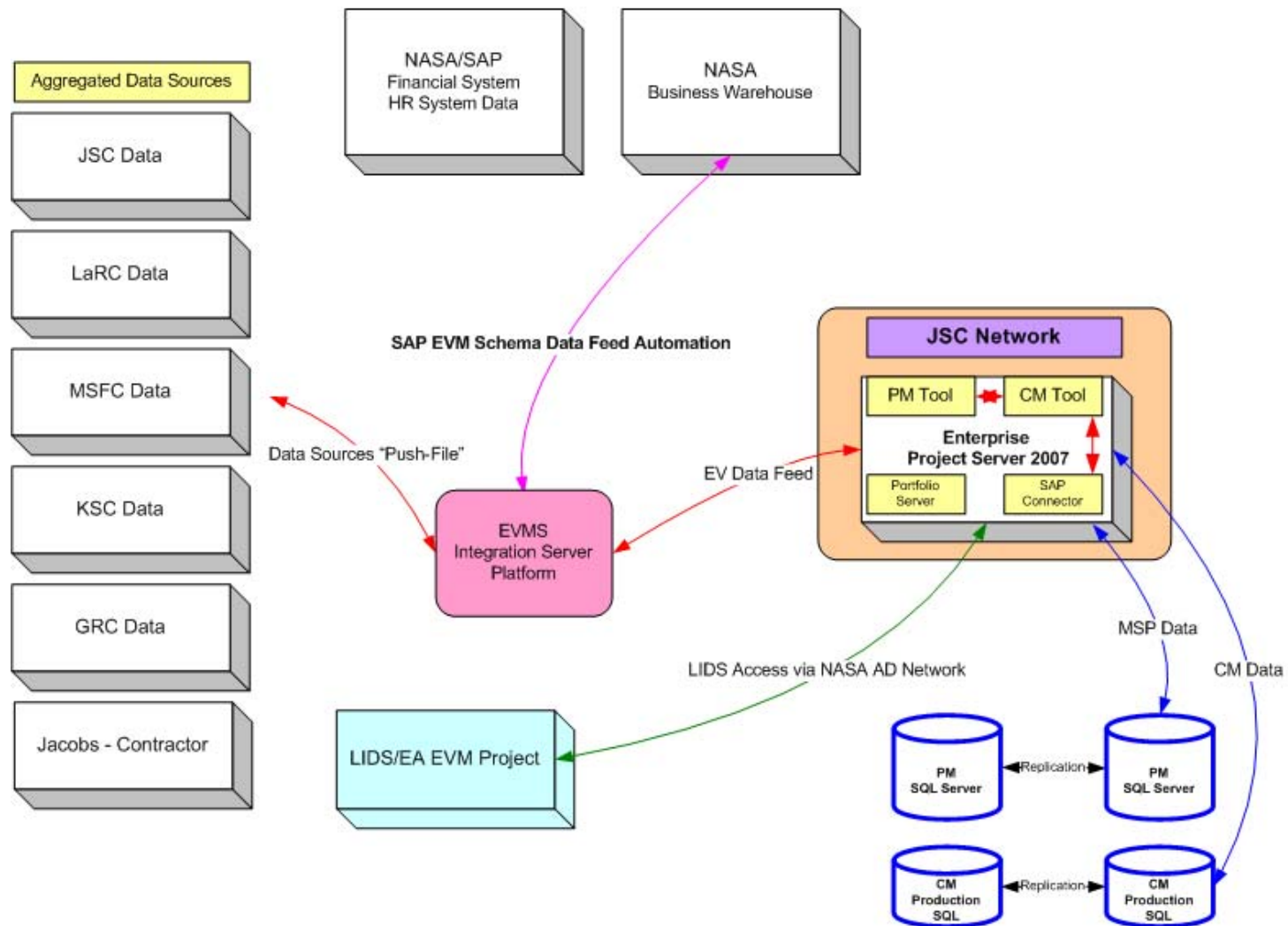
**Technical  
WBS**

1			Project Management Office								
1			Systems Engineering								
1			Analysis								
1			Mechanical								
1			Electrical								
1			Drafting / Checking								
1			Testing								
1											
1											
1											
1											
1											
1											
1											
1											
1											
1											
1											
1											
1	1.1	Project Management									
1	1.2	Systems Engineering									
1	1.3	Risk Reduction Unit (RRU)									
1	1.4	RRU Derivative-Hubble Space Telescope (HST)									
1	1.5	Engineering Development Unit (EDU)									
1	1.6	Adapter									
1	1.7	Flight Qual Unit (FQU)									

Project Manager - EA	Chief Engineer	Analysis Lead	Mechanical Lead	Electrical Lead	Checker Lead	Testing Lead
Steve Porter	Monty Carroll	Ben Quasius	Thang Le	Ray Morales	.	.



# Project Management Systems and Workflow Model







# Scheduling Tools – LIDS Manufacturing Schedule



	WBS	Task Name	Duration	Start	Finish	Risk	Control Account	Fixed Cost	Baseline Cost	Cost
1	1	DO80 REVISION 7 (R7) LIDS FABRICATION & ASSEMBLY SCHEDULE	291.5 days	Wed 7/25/07	Tue 9/30/08			\$ 0.00	\$ 943,912.00	\$ 943,912.00
2	1.1	DO80 R7 CONTRACT RELEASE SCHEDULE	38.5 days	Wed 7/25/07	Wed 9/19/07			\$ 0.00	\$ 0.00	\$ 0.00
26	1.2	DO80 R7 PROCUREMENT/MANUFACTURING/FABRICATION SCHEDULE	253 days	Wed 9/19/07	Tue 9/30/08			\$ 0.00	\$ 943,912.00	\$ 943,912.00
27	1.2.1	5.1.37 - RING GEAR TEST BED	91 days	Wed 9/19/07	Wed 2/6/08	5.1.37	C080-HS00-0100-WP37	\$ 144,007.00	\$ 144,007.00	\$ 144,007.00
74	1.2.2	5.1.38 - SixDOF LOADCELL ASSEMBLY	88 days	Wed 9/19/07	Fri 2/1/08	5.1.38	C080-HS00-0100-WP38	\$ 199,698.00	\$ 199,698.00	\$ 199,698.00
123	1.2.3	5.1.39 - UPGRADE LOWER HANDLING FIXTURE	85 days	Wed 9/19/07	Tue 1/29/08	5.1.39	C080-HS00-0100-WP39	\$ 53,584.00	\$ 53,584.00	\$ 53,584.00
157	1.2.4	5.1.40 - BLUE BOX #4 (BB4) ASSEMBLY	129.5 days	Wed 9/19/07	Tue 4/1/08	5.1.40	C080-HS00-0100-WP40	\$ 37,257.00	\$ 37,257.00	\$ 37,257.00
195	1.2.5	5.1.41 - EDU-54 ASSEMBLY	117 days	Mon 10/1/07	Tue 3/25/08	5.1.41	C080-HS00-0100-WP41	\$ 269,356.00	\$ 269,356.00	\$ 269,356.00
270	1.2.6	5.1.42 - MISCELLANEOUS STE/D FABRICATION SUPPORT	253 days	Wed 9/19/07	Tue 9/30/08	5.1.42	C080-HS00-0100-42xx	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00
274	1.2.7	5.1.43 - PASSIVE TUNNEL & BULKHEAD RING UNITS	128 days	Wed 9/19/07	Mon 3/31/08	5.1.43	C080-HS00-0100-WP43	\$ 140,010.00	\$ 140,010.00	\$ 140,010.00
290	*	DO 80 R7 COMPLETE	0 days	Tue 9/30/08	Tue 9/30/08			\$ 0.00	\$ 0.00	\$ 0.00

*Tool - Microsoft Project 2007*



# Detailed Planning & Schedule Development – at the Work Package Level



	i	WBS	Task Name	Duration	% Complete	Start	Finish	Control Account	Risk
1		1	DO80 REVISION 7 (R7) LIDS FABRICATION & ASSEMBLY S	291.5 days	21%	Wed 7/25/07	Tue 9/30/08		
2		1.1	DO80 R7 CONTRACT RELEASE SCHEDULE	38.5 days	87%	Wed 7/25/07	Wed 9/19/07		
26		1.2	DO80 R7 PROCUREMENT/MANUFACTURING/FABRICAT	253 days	21%	Wed 9/19/07	Tue 9/30/08		
27		1.2.1	5.1.37 - RING GEAR TEST BED	91 days	25%	Wed 9/19/07	Wed 2/6/08	C080-HS00-0100-WP37	5.1.37
74		1.2.2	5.1.38 - SixDOF LOADCELL ASSEMBLY	88 days	20%	Wed 9/19/07	Fri 2/1/08	C080-HS00-0100-WP38	5.1.38
75	✓	1.2.2.1	Start	0 days	100%	Wed 9/19/07	Wed 9/19/07		
76	✓	1.2.2.2	Decide NASA-JSC / NASA-WSTF / Outsource	1 day	100%	Wed 9/19/07	Thu 9/20/07		
77		1.2.2.3	OUT SOURCE WP38 FABRICATION	64 days	12%	Thu 9/20/07	Thu 12/27/07		
78	✓	1.2.2.3.1	Submit PR	3 wks	100%	Thu 9/20/07	Fri 10/12/07		
79		1.2.2.3.2	ESCG Procurement Secure Bids on all Parts	3 wks	93%	Fri 10/12/07	Fri 11/2/07		
80		1.2.2.3.3	Update Planning with Actual Cost Estimates	1 day	0%	Fri 11/2/07	Mon 11/5/07		
81		1.2.2.3.4	Award PO	3 days	0%	Mon 11/5/07	Thu 11/8/07		
82		1.2.2.3.5	FABRICATE WP38 OUT SOURCED	30 days	0%	Thu 11/8/07	Thu 12/27/07		
83		1.2.2.3.5.1	SDY44106363-001 BLOCK, BEARING, UJOIN	6 wks	0%	Thu 11/8/07	Thu 12/27/07		
84		1.2.2.3.5.2	SDY44106363-003 BLOCK, BEARING, UJOIN	6 wks	0%	Thu 11/8/07	Thu 12/27/07		
85		1.2.2.3.5.3	SDY44106364-001 YOKE, UNJOINT	6 wks	0%	Thu 11/8/07	Thu 12/27/07		
86		1.2.2.3.5.4	SDY44106365-001 BLOCK, UJOINT	6 wks	0%	Thu 11/8/07	Thu 12/27/07		
87		1.2.2.3.5.5	SDY44106366-001 SHAFT, UJOINT	6 wks	0%	Thu 11/8/07	Thu 12/27/07		
88		1.2.2.3.5.6	SDY44106369-001 WASHER, BEARING, UJC	6 wks	0%	Thu 11/8/07	Thu 12/27/07		
89		1.2.2.3.5.7	SDY44106269-001 LEG, LOCKDOWN, PASS	6 wks	0%	Thu 11/8/07	Thu 12/27/07		
90		1.2.2.4	IN HOUSE WP38 FABRICATION	55 days	21%	Thu 10/4/07	Fri 12/28/07		
114		1.2.2.5	COTS Hardware Purchase	14 wks	41%	Thu 9/20/07	Tue 1/8/08		
115		1.2.2.6	Receive \ Inspect WP 5.1.38	2 days	0%	Tue 1/8/08	Thu 1/10/08		
116		1.2.2.7	All WP38 Parts in hand	0 days	0%	Thu 1/10/08	Thu 1/10/08		
117		1.2.2.8	ASSEMBLE SixDOF LOADCELL ASSEMBLY	10 days	0%	Thu 1/10/08	Fri 1/25/08		
121		1.2.2.9	Deliver SixDOF Loadcell Assemblies via DD250	1 wk	0%	Fri 1/25/08	Fri 2/1/08		
122		1.2.2.10	WP38 COMPLETE	0 days	0%	Fri 2/1/08	Fri 2/1/08		
123		1.2.3	5.1.39 - UPGRADE LOWER HANDLING FIXTURE	85 days	20%	Wed 9/19/07	Tue 1/29/08	C080-HS00-0100-WP39	5.1.39
157		1.2.4	5.1.40 - BLUE BOX #4 (BB4) ASSEMBLY	129.5 days	25%	Wed 9/19/07	Tue 4/1/08	C080-HS00-0100-WP40	5.1.40
195		1.2.5	5.1.41 - EDU-54 ASSEMBLY	117 days	20%	Mon 10/1/07	Tue 3/25/08	C080-HS00-0100-WP41	5.1.41
270		1.2.6	5.1.42 - MISCELLANEOUS STE/D FABRICATION SUP	253 days	25%	Wed 9/19/07	Tue 9/30/08	C080-HS00-0100-42xx	5.1.42

Sub-Project DO80-M0





# Scheduling Tools - Project Web Access (PWA)



LIDS Team Project Server

Welcome Trueblood; Timothy

This Site

Site Actions

## Project Details: DO80\_R7\_SCHEDULE\_12\_19\_07

Project Details

New | Actions | Go To | Settings | View: Tasks Summary

Edit | Edit Project Properties | Build Team | | | |

ID	Task Name	Duration	Start	Finish	% Complete	Calendar
1	DO80 REVISION 7 (R7) LIDS FABRICATION & ASSEMBLY SCHEDULE	291.5d	7/25/2007	9/30/2008	39%	
2	DO80 R7 CONTRACT RELEASE SCHEDULE	38.5d	7/25/2007	9/19/2007	100%	
3	RFP RELEASE PROCESS	17d	7/25/2007	8/16/2007	100%	
12	PROPOSAL RELEASE PROCESS	13d	8/17/2007	9/6/2007	100%	
16	PROPOSAL APPROVAL PROCESS	9.5d	9/6/2007	9/19/2007	100%	
25	DO80 R7 ATP	0d	9/19/2007	9/19/2007	100%	
26	DO80 R7 PROCUREMENT/MANUFACTURING/FABRICATION SCHEDULE	253d	9/19/2007	9/30/2008	39%	
27	5.1.37 - RING GEAR TEST BED	129.5d	9/19/2007	4/1/2008	74%	
74	WP37 COMPLETE - RING GEAR TEST BED	0d	4/1/2008	4/1/2008	0%	
75	5.1.38 - SixDOF LOADCELL ASSEMBLY	110.5d	9/19/2007	3/5/2008	36%	
123	WP38 COMPLETE - SixDOF LOADCELL ASSEMBLY	0d	3/5/2008	3/5/2008	0%	
124	5.1.39 - UPGRADE LOWER HANDLING FIXTURE	89.5d	9/19/2007	2/4/2008	76%	
157	WP39 COMPLETE - UPGRADE LOWER HANDLING FIXTURE	0d	2/4/2008	2/4/2008	0%	
158	5.1.40 - BLUE BOX #4 (BB4) ASSEMBLY	129.5d	9/19/2007	4/1/2008	1%	
195	WP40 COMPLETE - BLUE BOX #4 (BB4) ASSEMBLY	0d	4/1/2008	4/1/2008	0%	
196	5.1.41 - EDU-54 ASSEMBLY	138d	10/1/2007	4/23/2008	21%	
270	WP41 COMPLETE - EDU-54 ASSEMBLY	0d	4/23/2008	4/23/2008	0%	
271	5.1.42 - MISCELLANEOUS STE/D FABRICATION SUPPORT	253d	9/19/2007	9/30/2008	0%	
274	WP42 COMPLETE - MISCELLANEOUS STE/D FABRICATION SUPPORT	0d	9/30/2008	9/30/2008	0%	
275	5.1.43 - PASSIVE TUNNEL & BULKHEAD RING UNITS	128d	9/19/2007	3/31/2008	0%	

Sub-Project DO80-M1



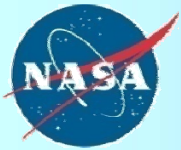
# Project Management Tools; COTS and Custom Tools



1	2	3	4	5	A	B	C	D	E	F	G	H
						<b>LIDS Earned Value Management and Budget Management Modeling Tool 2007-2008</b>						
						LIDS - Low Impact Docking System / Budget at Completion (BAC) 2007-2008		\$22,810,199.85				
								Planned Value	Oct-07	Nov-07	Dec-07	Jan-08
						Johnson Space Center	Control Account	\$19,410,836.85	\$1,205,880.95	\$1,767,407.82	\$1,425,662.84	\$1,521,580.00
						Glen Research Center	GRC-LIDS-CA-001	\$3,233,000.00	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67
						Goddard	GSFC-LIDS-CA-001	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
						Fab Alliance	FA-LIDS-CA-001	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
						Risk Items	RI-LIDS-CA-001	\$166,363.00	\$0.00	\$0.00	\$0.00	\$8,020.00
						TOTAL Planned Value		\$22,810,199.85	\$1,475,297.62	\$2,036,824.49	\$1,695,079.51	\$1,799,020.00
						EV						
								Earned Value	\$1,475,297.62	\$2,036,824.49	\$1,695,079.51	\$1,799,020.00
						Johnson Space Center	Control Accounts / Totals	\$1,493,404.00	\$1,493,404.00	\$1,871,900.00	\$1,727,800.00	\$1,389,000.00
						Glen Research Center	GRC-LIDS-CA-001	\$1,147,540.00	\$201,540.00	\$198,000.00	\$233,000.00	\$250,000.00
						Goddard	GSFC-LIDS-CA-001	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
						Fab Alliance	FA-LIDS-CA-001	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
						Risk Items	RI-LIDS-CA-001	\$39,500.00	\$0.00	\$0.00	\$0.00	\$7,500.00
						TOTAL Earned Value		\$8,419,004.00	\$1,493,404.00	\$1,871,900.00	\$1,727,800.00	\$1,812,300.00
						AC						
								Actual Cost	\$1,475,297.62	\$2,036,824.49	\$1,695,079.51	\$1,799,020.00
						Johnson Space Center	Control Accounts / Cost Code	\$875,954.00	\$875,954.00	\$1,381,362.00	\$1,425,000.00	\$1,655,700.00
						Glen Research Center	GRC-LIDS-CA-001	\$1,147,540.00	\$201,540.00	\$198,000.00	\$233,000.00	\$250,000.00
						Goddard	GSFC-LIDS-CA-001	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
						Fab Alliance	FA-LIDS-CA-001	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
						Risk Items	RI-LIDS-CA-001	\$39,500.00	\$0.00	\$0.00	\$0.00	\$7,500.00
						TOTAL Actual Cost		\$6,851,616.00	\$875,954.00	\$1,381,362.00	\$1,425,000.00	\$1,655,700.00
						Totals						
						Calcu						

*LIDS Developed Excel EVM Tool*





# EVM Tools - Continue



1	2	3	4	5	A	B	C	D	E	F	G	H
					1	LIDS Earned Value Management and Budget Management Modeling Tool 2007-2008						
					2							
					3	LIDS - Low Impact Docking System / Budget at Completion (BAC) 2007-2008						
					4			\$22,810,199.85				
					5			Planned Value	Oct-07	Nov-07	Dec-07	Jan-08
					6	Johnson Space Center	Control Account	\$19,410,836.85	\$1,205,880.95	\$1,767,407.82	\$1,425,662.84	\$1,521,588.99
					12	Project Management	JSC-CA-001	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
					23	Divisional Support	JSC-CA-002	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
					28	Procurements	JSC-CA-003	\$5,050,000.00	\$386,000.00	\$745,000.00	\$455,000.00	\$530,000.00
					29	ESCG (sub contractor)	JSC-CA-004	\$14,360,836.85	\$819,880.95	\$1,022,407.82	\$970,662.84	\$991,588.99
					30	DO80-R7	ESCG-DO80-001M1	\$1,340,000.00	\$84,000.00	\$102,000.00	\$118,000.00	\$123,000.00
					31	DO80-Rx	ESCG-DO80-00xM0	\$3,000,000.00	\$0.00	\$0.00	\$0.00	\$0.00
					32	DO106	ESCG-DO106-001M0	\$5,641,976.00	\$215,224.05	\$498,958.91	\$479,144.98	\$503,751.24
					33	TO72	ESCG-TO72-001M0	\$2,008,660.85	\$328,656.90	\$229,448.91	\$181,517.86	\$172,837.75
					34	Baseline Charges	ESCG-BCxx-001M0	\$2,370,200.00	\$192,000.00	\$192,000.00	\$192,000.00	\$192,000.00
					49	Glen Research Center	GRC-LIDS-CA-001	\$3,233,000.00	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67
					53	Goddard	GSFC-LIDS-CA-001	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
					57	Fab Alliance	FA-LIDS-CA-001	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
					61	Risk Items	RI-LIDS-CA-001	\$166,363.00	\$0.00	\$0.00	\$0.00	\$8,024.00
					62	TOTAL Planned Value						
					121			\$22,810,199.85	\$1,475,297.62	\$2,036,824.49	\$1,695,079.51	\$1,799,029.66
					180	EV						
					189	AC						
					204	Totals						
					205	Calcu						
					228	AdvC						





## EVM Tools - Continue

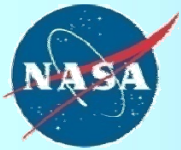


### ESCG - Support Contract

Planned Value	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
\$19,410,836.85	\$1,205,880.95	\$1,767,407.82	\$1,425,662.84	\$1,521,588.99	\$1,343,146.33	\$1,245,294.01	\$1,807,974.48	\$1,641,379.70	\$1,818,587.82	\$1,876,369.80	\$1,949,502.90	\$1,808,041.22
\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
\$5,050,000.00	\$386,000.00	\$745,000.00	\$455,000.00	\$530,000.00	\$318,000.00	\$207,000.00	\$534,000.00	\$399,000.00	\$445,000.00	\$325,000.00	\$301,000.00	\$405,000.00
\$14,360,836.85	\$819,880.95	\$1,022,407.82	\$970,662.84	\$991,588.99	\$1,025,146.33	\$1,038,294.01	\$1,273,974.48	\$1,242,379.70	\$1,373,587.82	\$1,551,369.80	\$1,648,502.90	\$1,403,041.22
\$3,233,000.00	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67
\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
\$166,363.00	\$0.00	\$0.00	\$0.00	\$8,024.00	\$38,000.00	\$35,000.00	\$46,000.00	\$21,300.00	\$18,039.00			
\$22,810,199.85	\$1,475,297.62	\$2,036,824.49	\$1,695,079.51	\$1,799,029.66	\$1,650,563.00	\$1,549,710.67	\$2,123,391.15	\$1,932,096.37	\$2,106,043.48	\$2,145,786.46	\$2,218,919.57	\$2,077,457.88

### DO80-R7

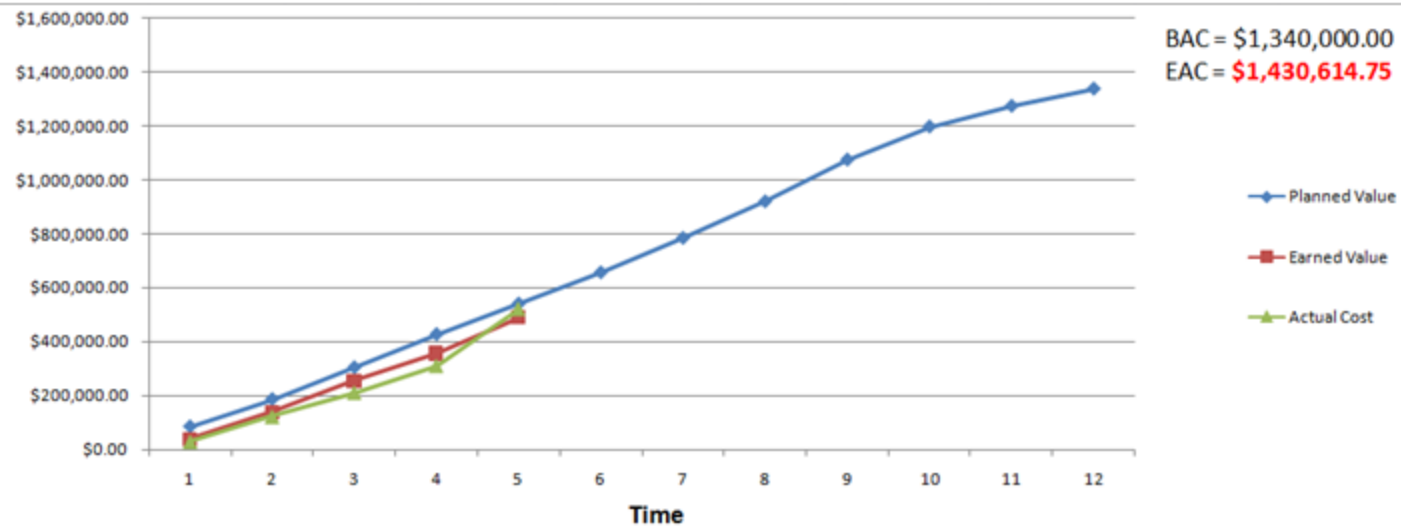
Planned Value	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
\$19,410,836.85	\$1,205,880.95	\$1,767,407.82	\$1,425,662.84	\$1,521,588.99	\$1,343,146.33	\$1,245,294.01	\$1,807,974.48	\$1,641,379.70	\$1,818,587.82	\$1,876,369.80	\$1,949,502.90	\$1,808,041.22
\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
\$5,050,000.00	\$386,000.00	\$745,000.00	\$455,000.00	\$530,000.00	\$318,000.00	\$207,000.00	\$534,000.00	\$399,000.00	\$445,000.00	\$325,000.00	\$301,000.00	\$405,000.00
\$14,360,836.85	\$819,880.95	\$1,022,407.82	\$970,662.84	\$991,588.99	\$1,025,146.33	\$1,038,294.01	\$1,273,974.48	\$1,242,379.70	\$1,373,587.82	\$1,551,369.80	\$1,648,502.90	\$1,403,041.22
\$1,340,000.00	\$84,000.00	\$102,000.00	\$118,000.00	\$123,000.00	\$114,000.00	\$116,000.00	\$128,000.00	\$136,000.00	\$155,000.00	\$123,000.00	\$77,000.00	\$64,000.00
\$3,000,000.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$195,000.00	\$295,000.00	\$430,000.00	\$645,000.00	\$804,000.00	\$631,000.00
\$5,641,976.00	\$215,224.05	\$498,958.91	\$479,144.98	\$503,751.24	\$521,369.34	\$543,171.67	\$561,197.49	\$504,327.72	\$500,387.26	\$500,351.76	\$427,450.92	\$386,640.66
\$2,008,660.85	\$328,656.90	\$229,448.91	\$181,517.86	\$172,837.75	\$197,776.99	\$187,122.34	\$197,776.99	\$115,051.98	\$96,200.56	\$91,018.04	\$115,051.98	\$96,200.56
\$2,370,200.00	\$192,000.00	\$192,000.00	\$192,000.00	\$192,000.00	\$192,000.00	\$192,000.00	\$192,000.00	\$192,000.00	\$192,000.00	\$192,000.00	\$225,000.00	\$225,200.00
\$3,233,000.00	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67	\$269,416.67
\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
\$166,363.00	\$0.00	\$0.00	\$0.00	\$8,024.00	\$38,000.00	\$35,000.00	\$46,000.00	\$21,300.00	\$18,039.00			
\$22,810,199.85	\$1,475,297.62	\$2,036,824.49	\$1,695,079.51	\$1,799,029.66	\$1,650,563.00	\$1,549,710.67	\$2,123,391.15	\$1,932,096.37	\$2,106,043.48	\$2,145,786.46	\$2,218,919.57	\$2,077,457.88



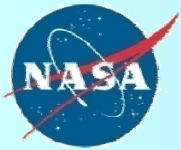
# EVM Tools Report



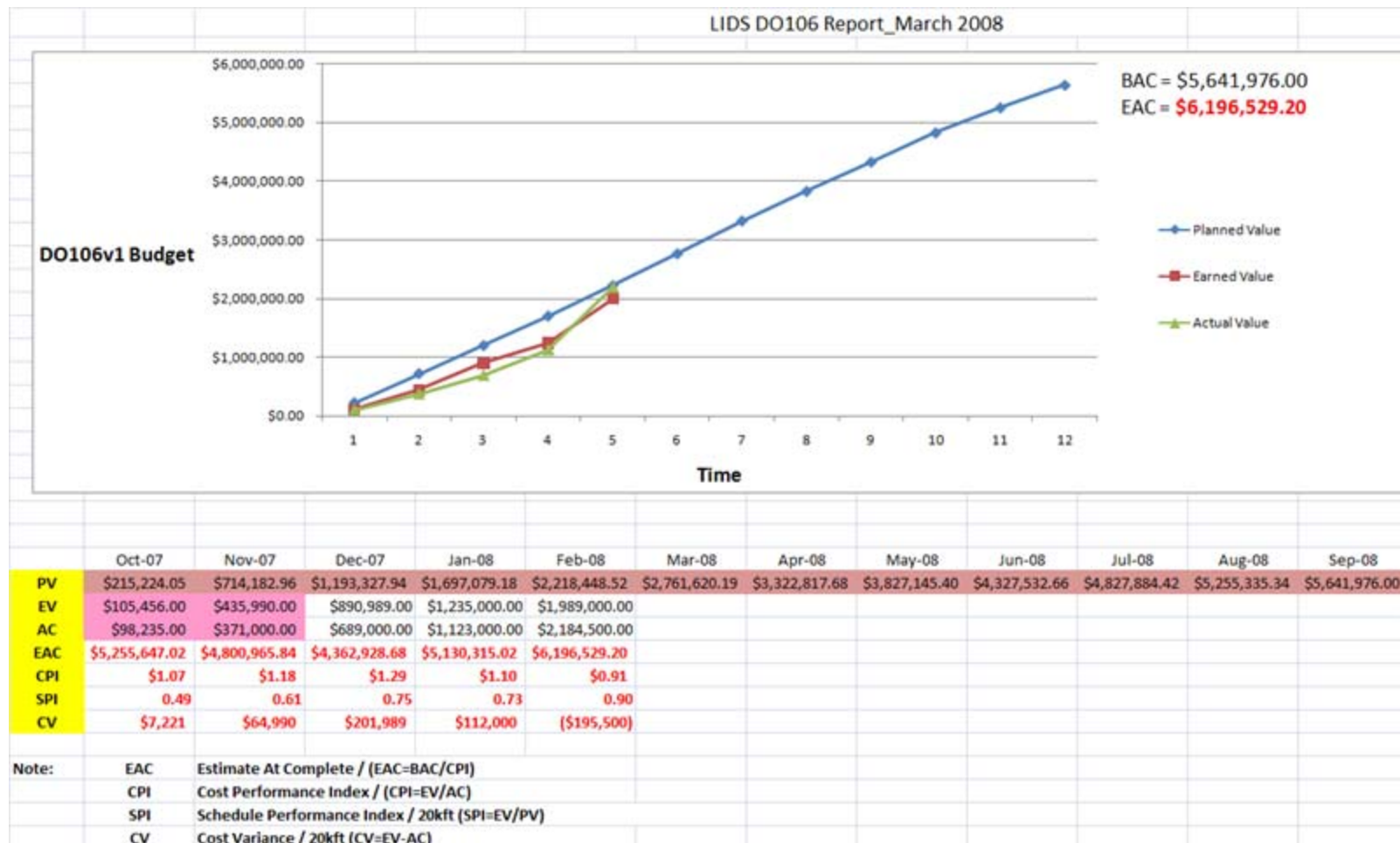
DO80-M1

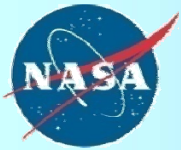


	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
PV	\$84,000.00	\$186,000.00	\$304,000.00	\$427,000.00	\$541,000.00	\$657,000.00	\$785,000.00	\$921,000.00	\$1,076,000.00	\$1,199,000.00	\$1,276,000.00	\$1,340,000.00
EV	\$39,840.00	\$138,450.00	\$255,000.00	\$356,000.00	\$488,000.00							
AC	\$28,540.00	\$121,545.00	\$211,000.00	\$310,000.00	\$521,000.00							
EAC	\$959,929.72	\$1,176,383.53	\$1,108,784.31	\$1,166,853.93	\$1,430,614.75							
CPI	1.40	1.14	1.21	1.15	0.94							
SPI	0.47	0.74	0.84	0.83	0.90							
CV	\$11,300	\$16,905	\$44,000	\$46,000	(\$33,000)							
Note:	EAC	Estimate At Complete / (EAC=BAC/CPI)										
	CPI	Cost Performance Index / (CPI=EV/AC)										
	SPI	Schedule Performance Index / 20kft (SPI=EV/PV)										
	CV	Cost Variance / 20kft (CV=EV-AC)										



# EVM Tools Report

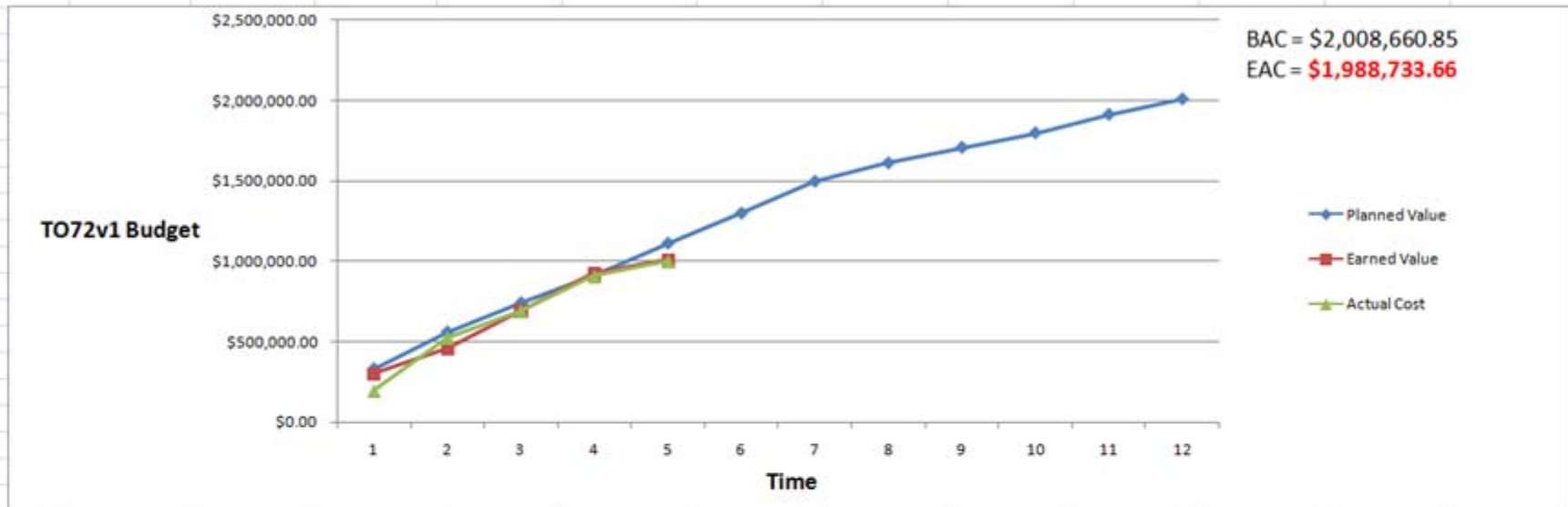




# EVM Tools Report



LIDS TO72 Report\_March 2008



	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
PV	\$328,656.90	\$558,105.82	\$739,623.68	\$912,461.43	\$1,110,238.42	\$1,297,360.75	\$1,495,137.74	\$1,610,189.72	\$1,706,390.28	\$1,797,408.32	\$1,912,460.30	\$2,008,660.85
EV	\$302,000.00	\$456,000.00	\$690,950.00	\$924,000.00	\$1,008,000.00							
AC	\$192,000.00	\$523,000.00	\$688,000.00	\$905,000.00	\$998,000.00							
EAC	\$1,277,029.42	\$2,303,793.04	\$2,000,084.91	\$1,967,357.22	\$1,988,733.66							
CPI	\$1.57	\$0.87	\$1.00	\$1.02	\$1.01							
SPI	0.92	0.82	0.93	1.01	0.91							
CV	\$110,000	(\$67,000)	\$2,950	\$19,000	\$10,000							

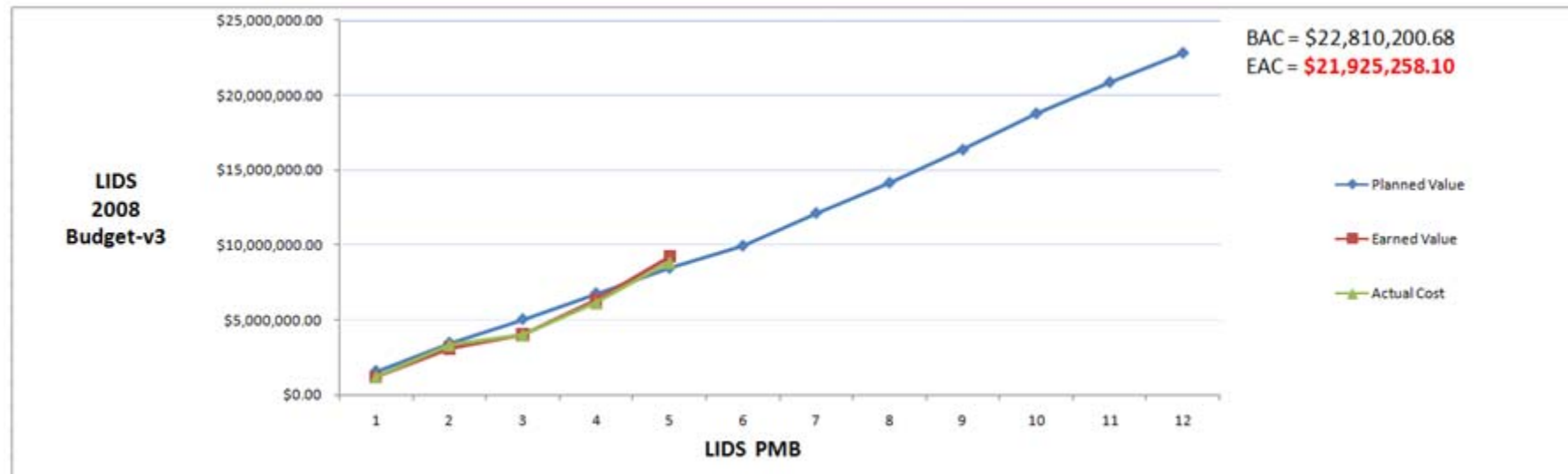
Note:

- EAC Estimate At Complete / ( $EAC = BAC / CPI$ )
- CPI Cost Performance Index / ( $CPI = EV / AC$ )
- SPI Schedule Performance Index / 20kft ( $SPI = EV / PV$ )
- CV Cost Variance / 20kft ( $CV = EV - AC$ )





# SCHEDULE ANALYSIS AND FORECASTING



	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
PV	\$1,544,403.57	\$3,436,269.15	\$5,014,203.68	\$6,746,877.35	\$8,430,544.01	\$9,922,078.68	\$12,105,117.35	\$14,128,534.01	\$16,339,950.68	\$18,761,367.35	\$20,856,784.01	\$22,810,200.68
EV	\$1,212,000.00	\$3,123,000.00	\$4,005,000.00	\$6,320,000.00	\$9,202,000.00							
AC	\$1,184,560.00	\$3,324,000.00	\$3,980,000.00	\$6,123,000.00	\$8,845,000.00							
EAC	\$22,293,771.71	\$24,278,292.37	\$22,667,814.91	\$22,099,186.51	\$21,925,258.10							
CPI	\$1.02	\$0.94	\$1.01	\$1.03	\$1.04							
SPI	0.78	0.91	0.80	0.94	1.09							
CV	\$27,440	(\$201,000)	\$25,000	\$197,000	\$357,000							
Note:	EAC	Estimate At Complete / (EAC=BAC/CPI)										
	CPI	Cost Performance Index / (CPI=EV/AC)										
	SPI	Schedule Performance Index / 20kft (SPI=EV/PV)										
	CV	Cost Variance / 20kft (CV=EV-AC)										





# Integrating EVM Process Standards



ANSI/EIA 748-32 Criteria Process Matrix	
Guideline Criteria	
<b>ORGANIZATION</b>	
1	Define WBS
2	ID Program Organization Structure
3	Company integration of EVMS/WBS/organization structure
4	ID Overhead control POC
5	Integrate Program WBS & organization structure
<b>PLANNING &amp; BUDGETING</b>	
6	Sequential scheduling of work
7	ID products/milestones/goals
8	Establish time-phased budget
9	Establish significant cost elements
10	ID discrete work packages
11	Sum all work package budgets & planning packages
12	ID LOE time-phased efforts
13	Establish overhead budgets for each significant organizational component
14	ID management reserve and undistributed budget
15	Reconcile program target cost goal with internal budgets
<b>ACCOUNTING</b>	
16	Record direct costs
17	Summarize direct costs into WBS
18	Summarize direct costs into organization element
19	Record indirect costs
20	ID unit costs, equivalent units costs or lot costs
21	EVMS cost accumulation by control accounts; cost performance measurement; accountability of material purchased for the program
<b>ANALYSIS</b>	
22	Control account monthly summary
23	Differences between planned and actuals, monthly
24	ID budgeted and actual indirect costs
25	Summarize data elements and variances
26	Implement management actions as result of EVM analysis
27	Revise EAC based on performance data; compare with PMB
<b>REVISIONS</b>	
28	Incorporate authorized changes
29	Reconcile budgets with prior budgets
30	Control retroactive changes
31	Prevent all but authorized budget changes
32	Document changes to PMB

Model Source – ANSI/EIA748



# Integrating EVM Processes into the Project



ANSI/EIA 748-32 Criteria Process Matrix		PROCESS GROUPING									
Guideline Criteria		ORGANIZING	SCHEDULING	WORK/BUDGET AUTHORIZATION	ACCOUNTING	INDIRECT MANAGEMENT	MANAGERIAL ANALYSIS	CHANGE INCORPORATION	MATERIAL MANAGEMENT	SUBCONTRACT MANAGEMENT	LIDS Project
<b>ORGANIZATION</b>											
1	Define WBS	X									X
2	ID Program Organization Structure	X							X		X
3	Company integration of EVMS/WBS/organization structure	X									X
4	ID Overhead control POC				X						X
5	Integrate Program WBS & organization structure	X									
<b>PLANNING &amp; BUDGETING</b>											
6	Sequential scheduling of work		X								X
7	ID products/milestones/goals		X								X
8	Establish time-phased budget			X	X						X
9	Establish significant cost elements	X		X				X	X		X
10	ID discrete work packages	X		X				X	X		X
11	Sum all work package budgets & planning packages			X							X
12	ID LOE time-phased efforts			X				X	X		X
13	Establish overhead budgets for each significant organizational component				X						X
14	ID management reserve and undistributed budget			X							X
15	Reconcile program target cost goal with internal budgets			X							X
<b>ACCOUNTING</b>											
16	Record direct costs				X				X		X
17	Summarize direct costs into WBS				X						
18	Summarize direct costs into organization element				X						
19	Record indirect costs					X					X
20	ID unit costs, equivalent units costs or lot costs				X						
21	EVMS cost accumulation by control accounts; cost performance measurement; accountability of material purchased for the program							X			X
<b>ANALYSIS</b>											
22	Control account monthly summary	X		X	X		X		X	X	X
23	Differences between planned and actuals, monthly		X				X		X	X	X
24	ID budgeted and actual indirect costs					X					X
25	Summarize data elements and variances						X				X
26	Implement management actions as result of EVM analysis	X					X				X
27	Revise EAC based on performance data; compare with PMB	X				X	X		X	X	X
<b>REVISIONS</b>											
28	Incorporate authorized changes							X			
29	Reconcile budgets with prior budgets							X			
30	Control retroactive changes				X			X			
31	Prevent all but authorized budget changes							X			
32	Document changes to PMB							X			X

Model Source – DoD EVMS Implementation Guide - 2006



# Standard EVM Analysis



## Cost

**Cost Variance / ( $CV=EV-AC$ )**

**Cost Performance Index / ( $CPI=EV/AC$ )**

**Percent Cost Variance /  $\%CV=CV/PV$**

## Schedule

**Schedule Variance / ( $SV=EV-PV$ )**

**Schedule Variance Percent /  $SV\%=SV/PV$**

**Schedule Performance Index / ( $SPI=EV/PV$ )**

## Analysis

**Estimate At Complete / ( $EAC=BAC/CPI$ )**

**Variance At Complete / ( $VAC=BAC-EAC$ )**

**Estimate To Complete / ( $ETC=(BAC-EV)/CPI$ )**



# Advanced EVM Analysis



## Complex EVM Analysis

**Estimate At Complete<sup>1</sup>** -  $EAC = AC + [(BAC - EV) / CPI] = BAC / CPI$

**Estimate At Complete<sup>2</sup>** -  $EAC = AC + [(BAC - EV) / ((EV_i + EV_j + EV_k) / (AC_i + AC_j + AC_k))]$

**Estimate At Complete<sup>3</sup>** -  $EAC = AC + [(BAC - EV) / (CPI \times SPI)]$

**Estimate At Complete<sup>4</sup>** -  $EAC = AC + [(BAC - EV) / (.8 CPI + .2 SPI)]$

**Time-Based Schedule Measures** -  $SV(t) = PT - AT$

**Time-Based Schedule Measures** -  $SPI(t) = PT / AT$

**Time-Based Schedule Measures** -  $SV(\$) = EV - PV$

**Time-Based Schedule Measures** -  $SPI(\$) = EV / PV$

**TCPI** =  $BAC - BCWP / EAC - ACWP$

**TCPI** = Remaining Budget/Current Estimate To Complete

Over 1.0 = Projected Favorable Cost Performance

Under 1.0 = Projected Unfavorable Cost Performance

**PT** = Planned Time

**AT** = Actual Time

Note 1. Future cost performance will be the same as all past cost performance

Note 2. Future cost performance will be the same as the *last three measurements period* ( $l, j, k$ )

Note 3. Future cost performance will be influenced additionally by past schedule performance

Note 4. Future cost performance will be influenced jointly in some proportion by both indices



## ***Lessons Learned --- What we have learned, so far.....***



### ***The three things we did right;***

- ***We honestly assessed where we were from the start, and we defined our objectives - both short-term and long-term for management and EVM Practices & Processes***  
***better project integration***
- ***We planned a detailed solution; considered the barriers and based it on how we get work done at JSC***  
***opportunities...and***
- ***We dedicated the right resources; with a constant eye on improvement in project and process maturity and the collaboration with managers***  
***other GFE project***

### ***And, the three things we did wrong;***

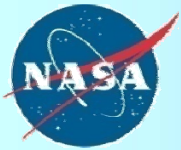
- ***At first, we bought into the one-size fits all***
- ***We underestimated the required project level commitment - EVM solution, detailed project management knowledge, and the resources needed for a meaningful EVM solution***
- ***We should have got started much sooner....***

***Questions?***

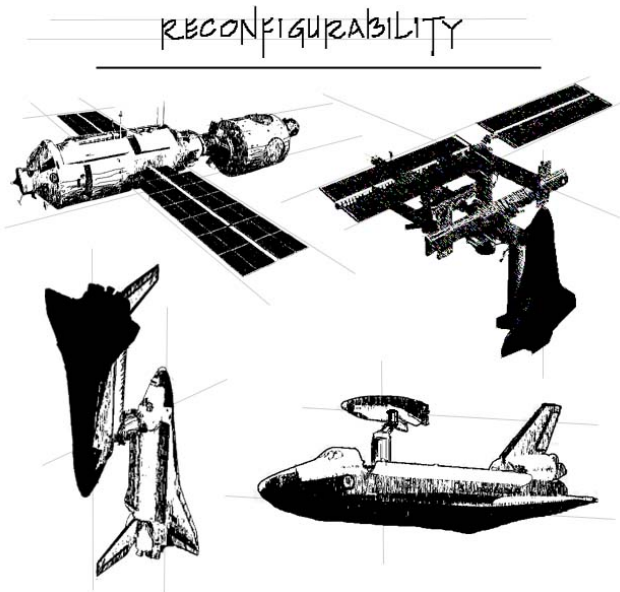
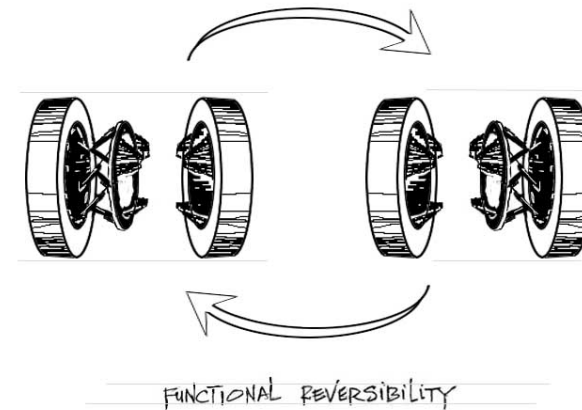
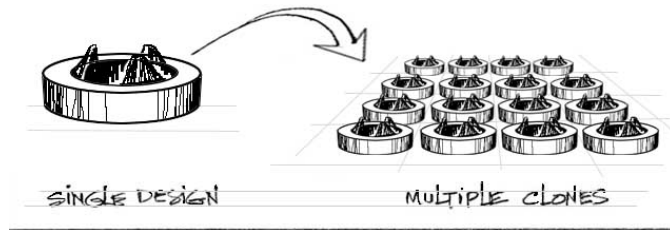


## ***More LIDS Product Stuff – Backup Slides***

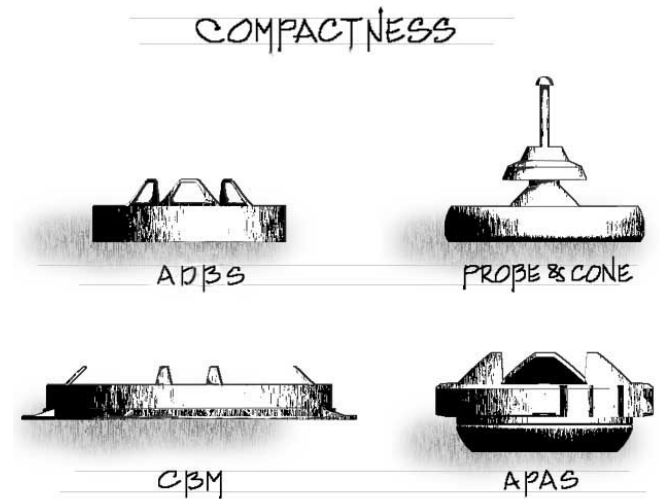


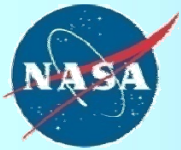


# LIDS – Background - What is it? Why is it different?




$$F \leq 50 \text{ lbf}$$





## ***Background: LIDS Capture Video - How's it work?***



***LIDS Docking Operation***



***LIDS 6DOF Testing***



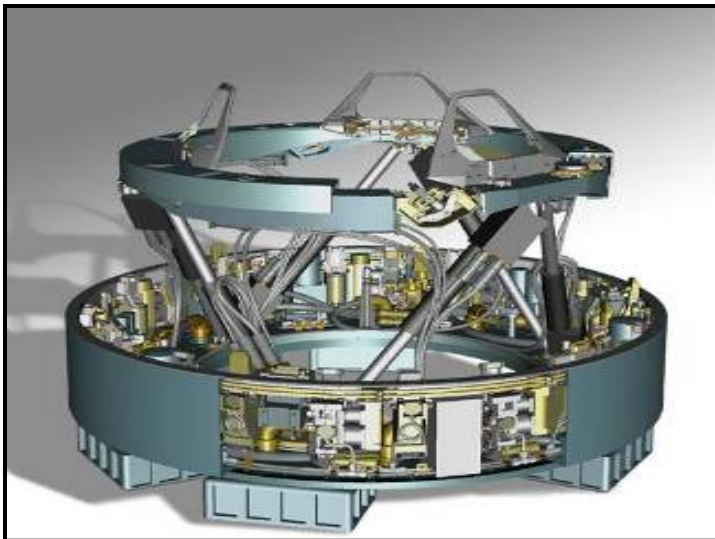


## ***LIDS – Background - Where are we now?***



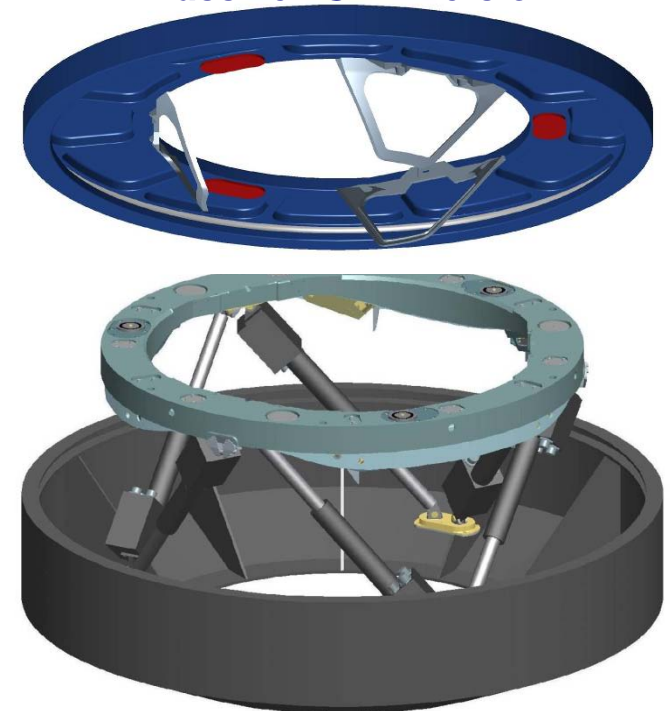
### **Summary of recent development periods**

- ♦ Fall 2006 LIDS became active GFE project
  - Level 2 delegated project oversight authority to CEV
  - Conducted SRR in May '07
- ♦ CEV Weight Lien Scrub Conducted Summer/Fall '07
  - Significant modification to requirements and design
  - PDR Currently Planned for March '08



***LIDS Original Generic Configuration***

***Passive LSAM Version***



***LIDS Simplified CEV Version  
(Structural Elements Only Shown)***

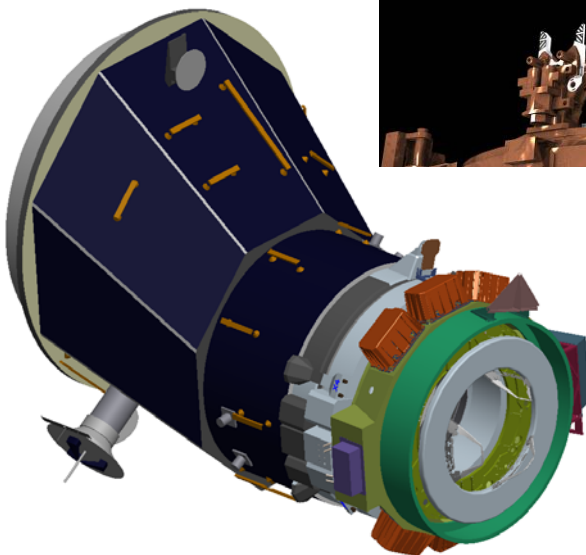
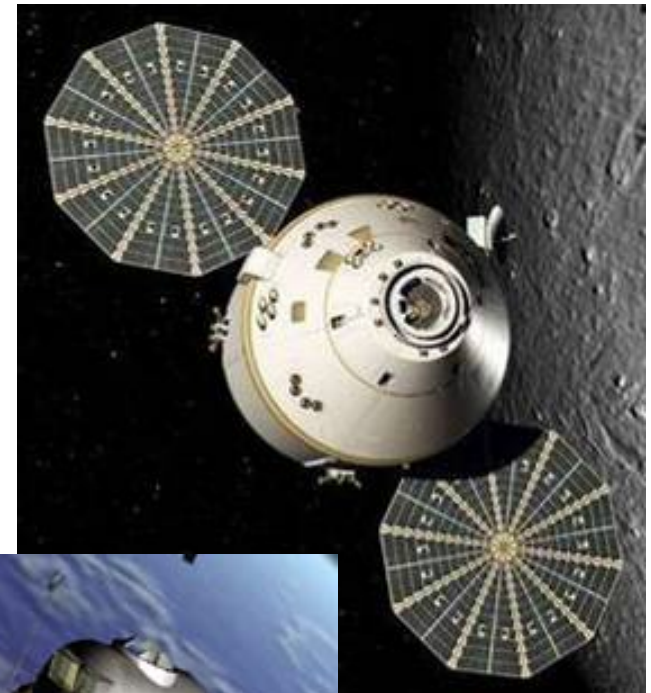
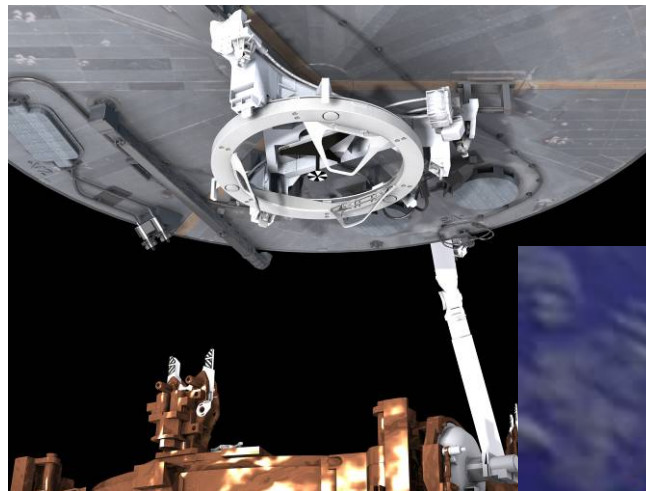




## *Identified LIDS users*



- ◆ Crew Exploration Vehicle (CEV)
- ◆ Lunar Surface Access Module (LSAM)
- ◆ LIDS APAS Adapter to ISS
- ◆ LIDS Hubble Passive Interface (LIDS HST)





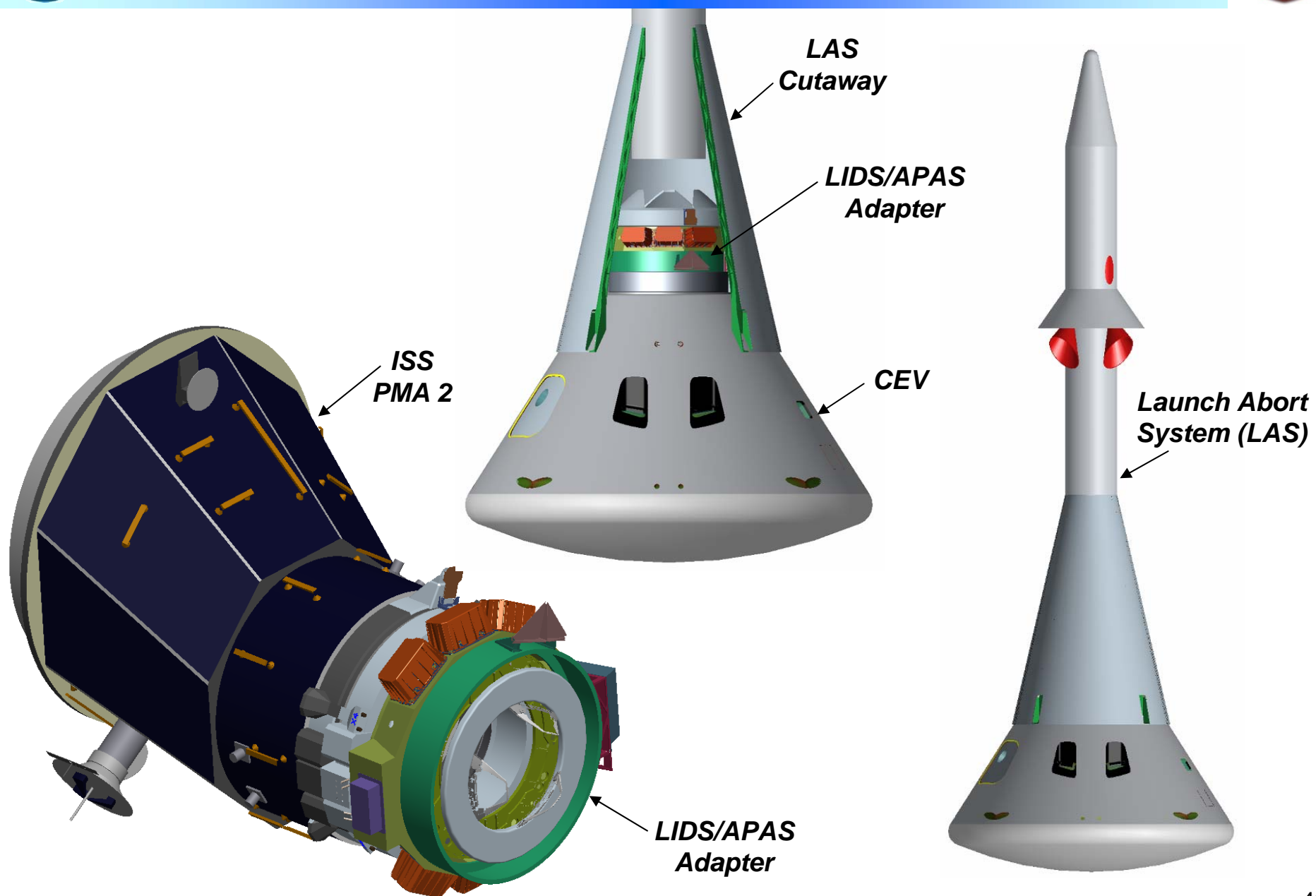
## *LIDS on CEV & LSAM*

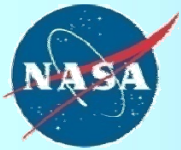




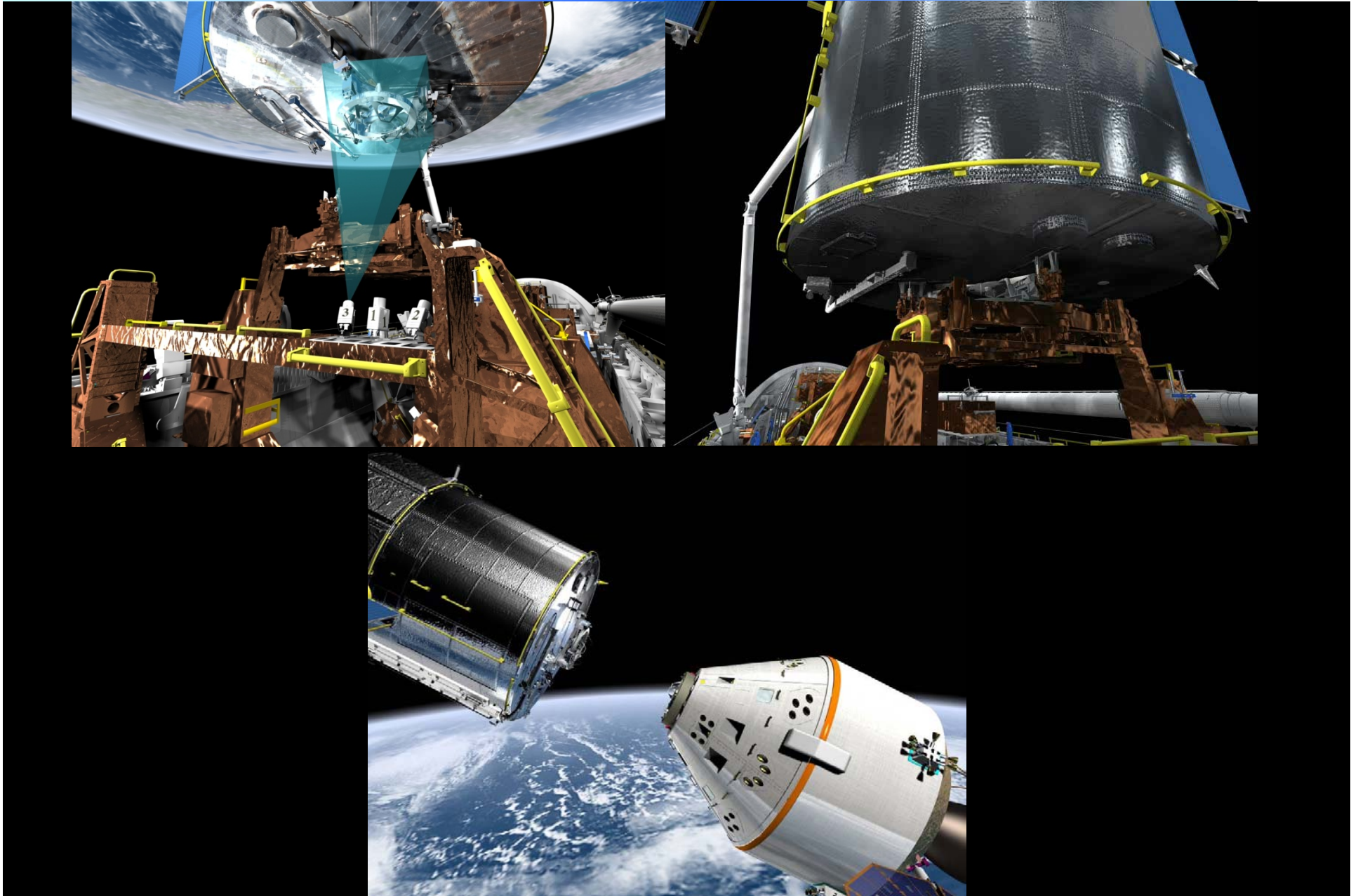


## *LIDS Adapter Delivery to ISS (“Party Hat”)*





## *LIDS on Hubble*





## ***LIDS – Hardware Deliverables***



### ♦ **Engineering Dev Units**

- 1 LIDS
- 1 Passive LIDS

### ♦ **Flight Qual Units**

- 2 LIDS
- 1 Adapter
  - 1 Passive LIDS

### ♦ **Flight Units**

- 4 LIDS
- 2 Adapter
  - 2 Passive LIDS

### ♦ **Other**

- 2 LIDS Master Tools (1 active + 1 passive)
- Simulators
- 1 Avionics set for an iron bird including LIDS emulator
- Handling fixtures for adapter and LIDS (as req'd)
- 1 set of spare active components